Enabling Photodetection Technology

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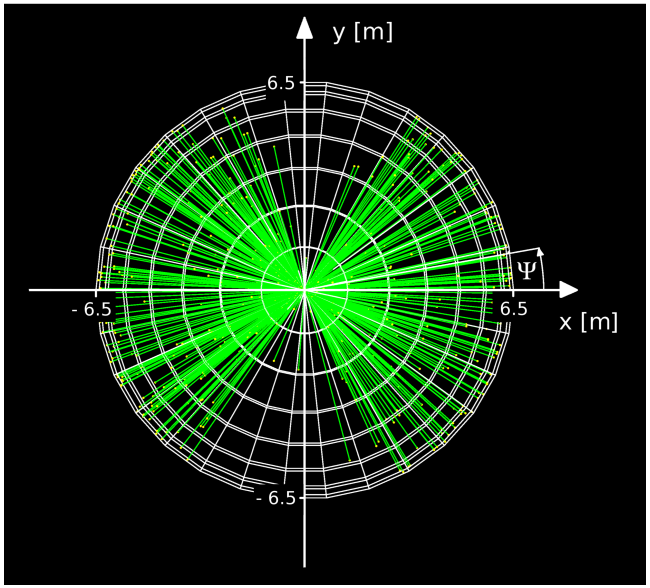

Snowmass - Neutrino-less Double Beta Decay Beyond the Ton Scale

Dec 11, 2020

Next Generation Photon Detectors

The real impact will come, not only by improving how photosensors perform

- time resolution
- spatial granularity
- quantum efficiency/area coverage
- wavelength dependent response
- photon counting
- cost

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…but also by improving how photosensors are *used*

- light collection
- precision single photon likelihoods (ANNIE/WATCHMAN/Theia)
- dual Cherenkov-scintillation systems (ANNIE/WATCHMAN/Theia)
- optical imaging: reflective/refractive geometries (Oberla et al, Dalmasson et al)

  https://arxiv.org/abs/1510.00947 https://arxiv.org/abs/1711.09851

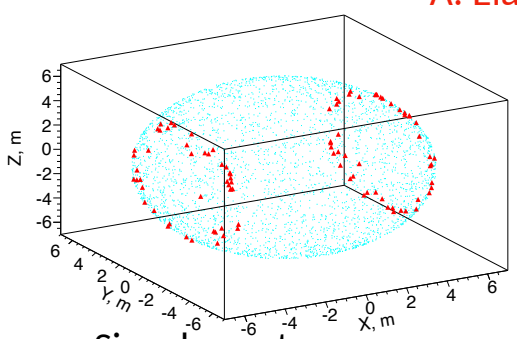
- Photon sorting: by color (Kaptanoglu et al), by polarization

  https://arxiv.org/abs/1912.10333

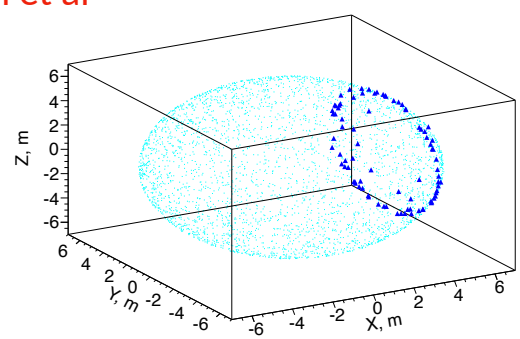
Topology is Important for 0nubb…and every photon counts

- Cherenkov + Scintillation light = tracking + calorimetry
- Timing, color, and polarization can be used to separate between the two

A. Elagin et al



Signal event:
two 1.56 MeV electrons



^{8}B background event:
single 2.53 MeV electron

https://arxiv.org/abs/1902.06912

https://arxiv.org/abs/1812.02906

https://arxiv.org/abs/1609.09865

Theia:

https://arxiv.org/abs/1911.03501

- Imaging photodetectors allow reconstruction in a much wider phase space
- Coming up with the most efficient way to exploit that information is open problem
- Some interesting non-0nbb efforts provide opportunities to exploit those new ideas